Traffic Engineering & Highway Safety Bulletin

Military Traffic Management Command Transportation Engineering Agency
720 Thimble Shoals Boulevard, Suite 130 • Newport News, VA 23606-4537

June 2003

Gates Revisited

INTRODUCTION

There are three priorities or objectives in the operation of most gates. In order of importance, they are:

- ❖ Security (force protection)
- ❖ Safety of guards and motorists
- ❖ Traffic flow (congestion reduction)

Due to heightened security since September 11, many installations have experienced severe congestion and significant delays at their gates. Most often, this congestion has lead to reduced safety. Realizing this level of security may continue in the future, this bulletin is intended to supplement the *Traffic Engineering for Better Gates Bulletin*, dated August 2001.

In This Issue:

GATE CAPACITY

MTMCTEA has performed over 40 gate security, safety, and capacity traffic engineering studies since September 11. During these studies, we have collected significant data, which has allowed us to establish new criteria regarding capacity and processing rates at gates.

Number of ID Checkers

To reduce congestion at gates, many installations use additional guards, or checkpoints per lane. Some installations use as many as nine guards to process a single traffic lane.

Figure 1 (page 2) graphically depicts processing rates using the same number of guards for two different lane configurations. As shown, two guards in two lanes is the more efficient use of manpower.

Does adding guards to a lane increase its capacity? Yes. Is the level of increase worth the extra manpower? No, not if more than three ID checkers are used per lane, as Table 1 shows.

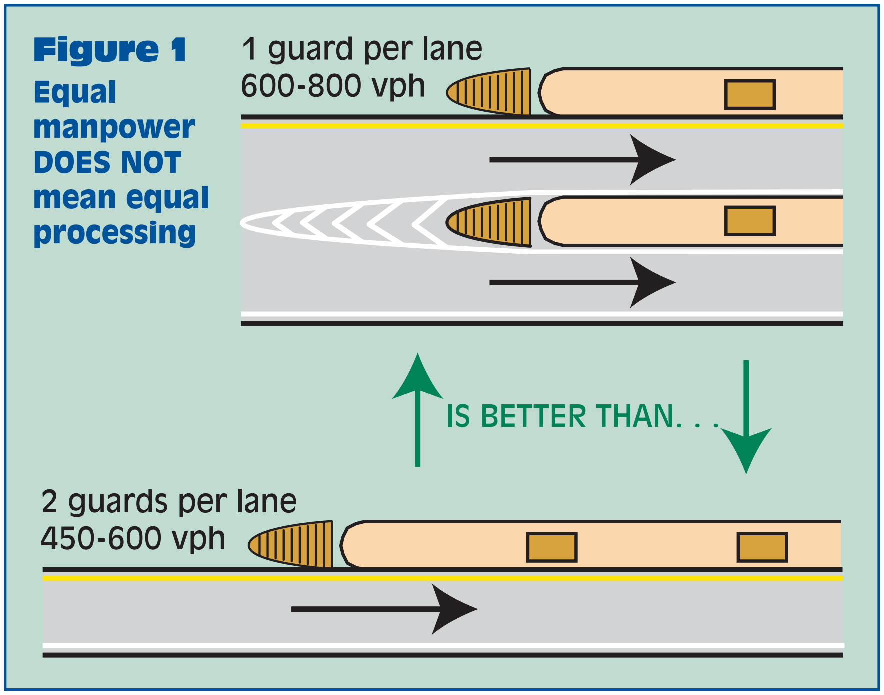
Table 1

# of ID Checkers Per Lane	Processing Rate (vphpl)*	Incremental Increase (vphpl)*
1	300-400	-
2	450-600	50%
3	525-700	17%
4	More than three ID checkers provides little increase in the processing rate.	

** Vphpl - Vehicles per hour per lane.*

Notes:

1. *100% ID check of driver and all passengers (Bravo Plus Condition).*
2. *Most important factor in range of capacity is attributed to assertiveness of guards.*



Inspection Areas

In-lane vehicle inspection is a primary cause of capacity reductions at gates.

For example, one gate that MTMCTEA studied had a peak demand of approximately 1,300 vph, inbound. The gate processed 321 vphpl in each of three inbound lanes during the peak hour. The excess demand or queue, during the peak hour, was approximately 330 vehicles.

Gate ID checkers performed random in-lane inspections of approximately 1 in 30 vehicles, or 32 total during the peak hour. These inspections consumed 27 minutes per lane per hour based on a typical inspection time of 2 to 3 minutes per vehicle. If the inspections were removed from the roadway, the installation could process vehicles for the full hour, rather than for only 33 minutes. This 182 percent increase in available processing time equates to a processing rate of 584 vphpl.

With this new processing rate, the peak hour demand could be met with no queuing or delay. A separate vehicle inspection area is extremely important to the efficiency of a gate.

Visitor Traffic

In addition to separating inspection activities from processing lanes, it is also important to separate visitors from decal traffic. Ideally, a visitor's reception center should be provided at the Main Gate to process visitor traffic. Appropriate signing should be installed to direct visitors to this gate.

Commercial Gates

In terms of processing, large trucks and their respective inspection activities are much different from those activities associated with other vehicle types. Safety is also an issue since truck movements can present a hazard to smaller vehicles. Many installations require a separate truck entrance. This requirement is dependent on several factors: installation mission and location, installation population, truck traffic volume, security procedures, and the availability of land.

What's Wrong With This Photograph?

Answer on Page 7

GATE SAFETY

With an increase in security, many installations require additional safety elements at their gates.

Raised Guard Island

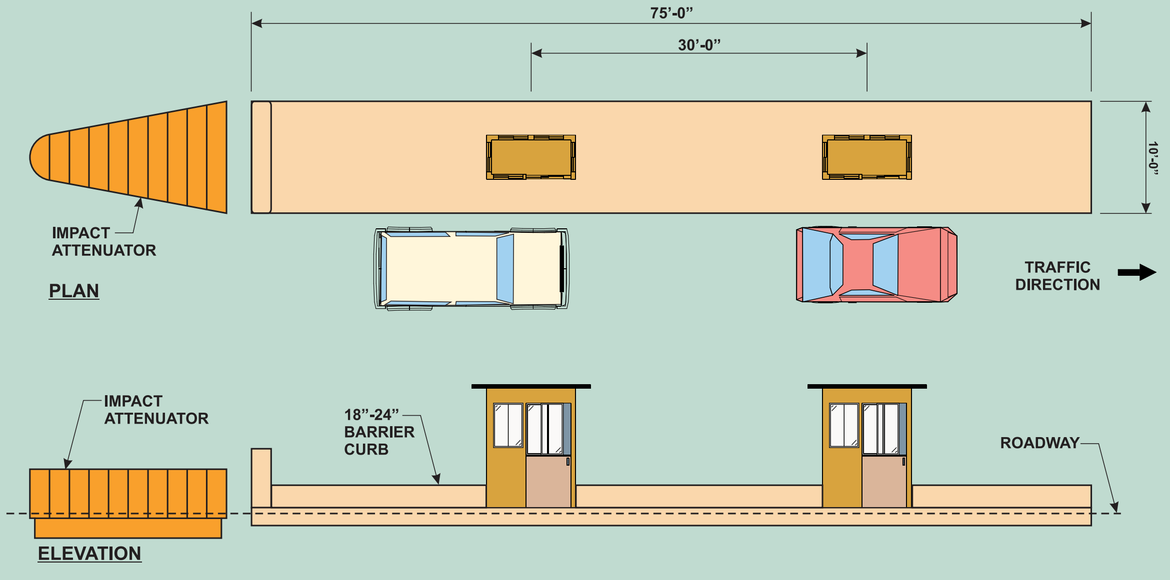
Where multiple lanes are used to process vehicles, guards are forced to stand between lanes of moving traffic.

A raised concrete island provides a measure of safety and separation from this traffic. Figure 2 provides details on the preferred design of a guard island.

Barrier Curb

Barrier curb is used to contain vehicles within the travel lanes and to prevent vehicles from driving onto the guard island. Typical barrier curb height is 18-24 inches.

Figure 2 Preferred design of a guard island



Attenuators

Impact attenuators at the approach end of each raised island (Figure 2) protect guards and guard booths from vehicular impacts.

They also protect motorists from potential fixed object impacts. Impact attenuators should conform to FHWA *National Cooperative Highway Research Program Report 350 (NCHRP 350).*

Lighting

Lighting is extremely important for safety and processing activities in gate areas. Here are a few criteria/guidelines to consider:

- Multiple fixtures per pole are more economical and efficient for area coverage.
- Use low-level, directed (from behind guard) lighting for ID processing (5 to 10 foot candles).
- Use 400-watt High-Pressure Sodium (HPS) lamps on gate approaches and at processing points. Use Metal Halide or Deluxe HPS lamps at inspection areas.
- Require a color rendition index of 65 (measure of color distinction). This criterion is critical at inspection areas.

ARRESTING DEVICES

For force protection reasons, many installations require arresting devices within the gate area.

Some considerations when choosing a device include:

- *Response Time:* How quickly can the device be deployed if a motorist breaches security?
- *Severity of Impact:* If deployed, how likely is personal injury or property damage?
- *Reliability:* False deployment of the device could cause harm to an innocent motorist.
- *Cost:* As always, cost is a consideration.

Table 2 describes the pros and cons associated with each device and provides information on cost and operation:

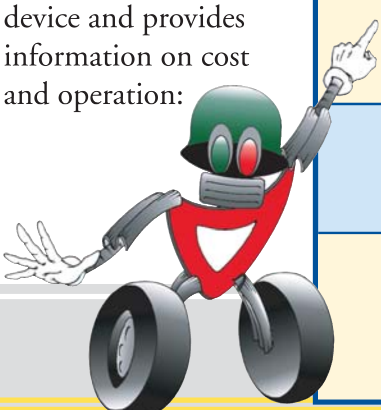
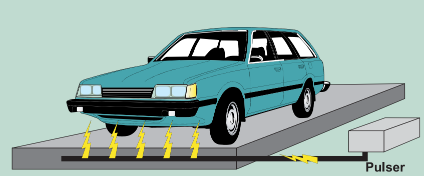


Table 2	Pop-up Bollards/Barricades 	Electronic Systems 
Operation	❖ Device installed in roadway and activated by hydraulic or pneumatic means ❖ Deploys in less than 2 seconds when activated by guard ❖ Can be used in conjunction with card reader to raise and lower for each approved vehicle	❖ Damages sensitive ignition and engine-control electronics of a vehicle by injecting large electromagnetic pulses ❖ Control box allows guard to arm and disarm power supply via hard wire or remote control
Pros	❖ Numerous safety measures can be utilized to avoid unintentional deployment (i.e. induction loops in roadway) ❖ Deployment as fast as 1.5 seconds ❖ Bollards crash tested for 15,000 lbs. at 50 mph ❖ Barriers crash tested for 20,000 lbs. at 78 mph	❖ Once pulser fires, other vehicles should be able to safely pass over system ❖ Vehicle coasts to a safe stop and, in most vehicles, some power is still provided to power brakes and steering ❖ Can be employed permanently or temporarily ❖ Non-impacting
Cons	❖ High maintenance to ensure proper operation and to avoid accidental deployment ❖ Heating mechanism required in cold weather climates to prevent ice buildup on mechanical parts ❖ Concerns with reliability and possibility of deployment on innocent motorist ❖ Fixed-object impacting	❖ No extensive studies have been performed to show that there are no adverse effects to individuals exposed to the electromagnetic fields ❖ One vendor has halted additional development of these systems because of major technical issues which they believe need to be resolved ❖ Not effective on vehicles without electronic ignition systems (those prior to mid-1980s)
Initial Cost	$31k to $44k for single lane	Not available
Web Links	*http://www.deltascientific.com* *http://www.secureusa.net* *http://www.armrservices.com* *http://www.atgaccess.com*	*http://www.jaycor.com/eme/auto.htm* *http://ckent.org/nlt.html*

Some of the above photos are courtesy of Secure USA, Inc; Entwistle Co.

Vehicle Arresting Net 	Crash Beams 	Tire Spikes/ Claws 
❖ Adaptation of aircraft arresting net technology ❖ Uses chain link fence or fiber nets attached to customized energy absorbers ❖ Air Force Non-Lethal Systems is developing a Portable Vehicle Arresting Barrier (PVAB) net that deploys from the roadway surface	❖ Crash beam includes a high-strength wire rope attached to cast-in-place cement buttresses ❖ Hydraulic means used to raise and lower beam ❖ In a collision the energy is transferred through the beam and to the buttress and foundation	Two types: *Upright* ❖ Punctures tires of vehicles driving in wrong direction ❖ Spikes depress allowing travel in permitted direction *Remote* ❖ Spikes rise only when activated by guard
❖ Provides safe, controlled stop with minimum damage to vehicle ❖ Not affected by environmental conditions ❖ Air Force PVAB will be capable of deploying in under 2 seconds ❖ Air Force PVAB will be capable of stopping vehicles weighing 14,000 lbs and traveling at 60 mph ❖ Non-impacting	❖ Numerous operating modes include loops, remote, card reader, key switch, and push button ❖ Crash tested for 15,000 lbs. at 30 mph	❖ Minimal property damage ❖ Personal injury unlikely ❖ Heating element can allow use in cold weather climates ❖ Remote devices are flush with ground and snowplowable ❖ Deployment of remote device in as fast as 1 second ❖ Non-impacting
❖ Some require energy absorbers, which are costly to replace after deployment ($10,000) ❖ Tower-mounted nets are not aesthetically pleasing ❖ After coming to a stop, the driver may be able to back up vehicle and then drive over net ❖ If tower mounted, there is a 20 second deployment time	❖ Lowering of beam takes a minimum of 5 seconds ❖ Will stop a heavily loaded vehicle only if traveling at low to moderate speeds (15,000 lbs. at 30 mph) ❖ Safety concerns if deployed on innocent motorist ❖ Fixed-object impacting ❖ Does not posess the longevity of barricades	❖ Vehicles may continue to travel on flat tires ❖ Not designed for roads with high traffic volumes or where speeds exceed 5 mph (upright) ❖ Damage is possible from snowplows (upright)
$200k for tower system and net	$19k to $25k for single lane	$25k for one to three lanes
http://www.entwistleco.com *http://www.crashcushions.com* *http://www.energyabsorption.com*	http://www.deltascientific.com http://www.secureusa.net http://www.armrservices.com	*http://www.catsclawinternational.com*

NEW GATE DESIGN CONCEPT - *Speed Ratchet*

Installations have attempted to slow both inbound and outbound gate traffic using numerous devices. The most commonly used device is temporary concrete barrier, which is used to accomplish the speed reduction as well as reduce the threat of unauthorized entry. However, use of these barriers often results in geometric constraints and unsafe conditions for the innocent motorist.

The Speed Ratchet design, shown in Figure 3, is intended for use at access control points consisting of one lane per direction; this may or may not be the main gate.

Concrete barriers slow vehicles by deflecting them. The Speed Ratchet deflects as well but does so in a safe manner and achieves the following goals:

- Safely reduces vehicle speeds to below 25 mph.
- Accommodates truck movements.
- Slows unauthorized vehicles attempting to enter installation in outbound lanes.
- Allows for turnaround of passenger cars either before or after guardhouse.
- Circle area can be used for low-height plantings, flagpole, etc. to create an aesthetically pleasing gateway to the installation.
- Barrier curb on inside and outside of circle offers protection for security forces and acts as a barrier to errant vehicles.

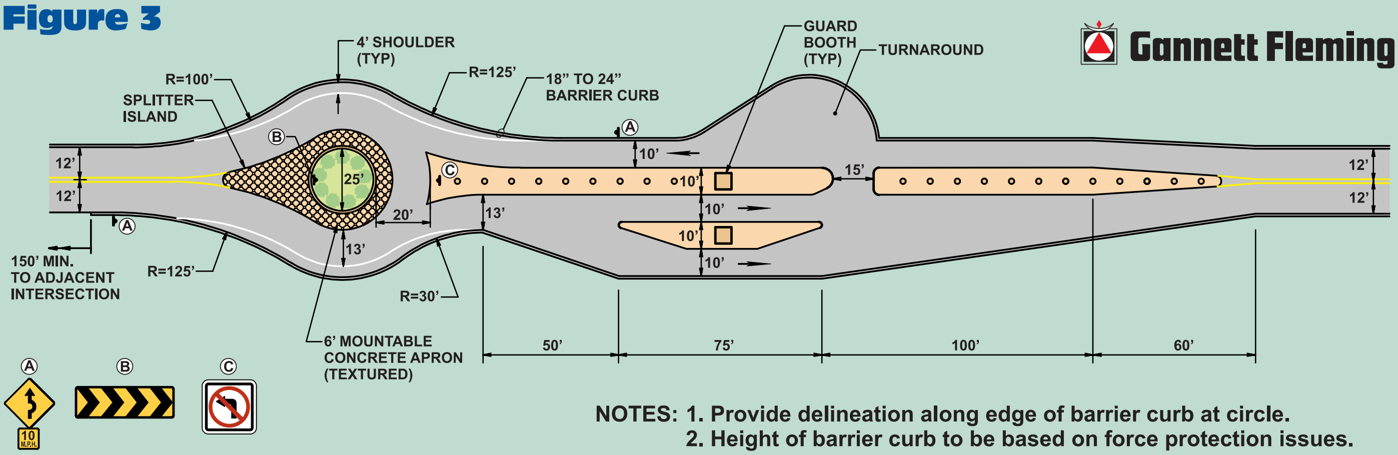
Continued on Page 7

MTMCTEA Can Help!

MTMCTEA highway engineers stand ready to help installations with their traffic engineering concerns—especially those involving high crash locations or access control. We perform many types of studies with an emphasis on low-cost improvements that are immediate or short-term and yield high benefits to their implementation costs. Generally, the studies conducted include:

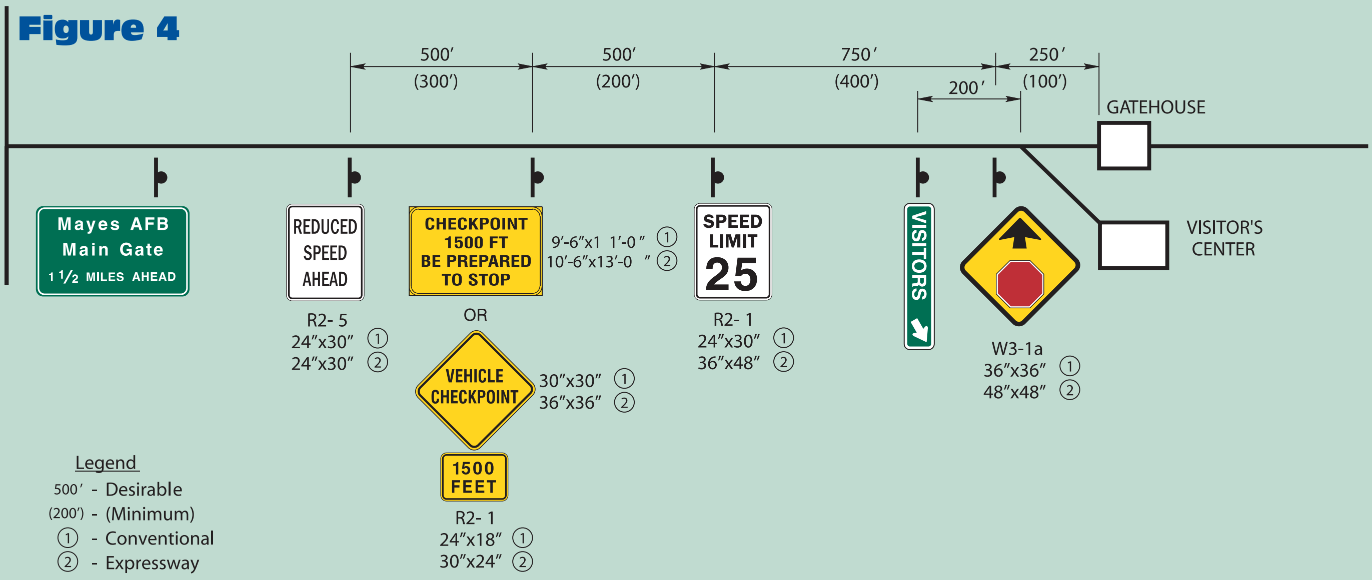
- Access control
- Access roads
- Fatal crash analysis
- Force protection
- High crash locations
- Safety audits
- Signal operations
- Traffic calming evaluations
- Traffic engineering
- Traffic impact (such as BRAC)

Figure 3



NOTES: 1. Provide delineation along edge of barrier curb at circle.
2. Height of barrier curb to be based on force protection issues.

Figure 4



Continued from Page 6

- The outside lane can be used as an additional processing lane during peak hours and as an inspection lane during off-peak hours. A third processing lane can be added, if needed.

There are some disadvantages associated with the Speed Ratchet design. They include:

- Requires more land area and is more expensive to construct than a conventional gate design.
- If circle is landscaped, regular maintenance will be required.

SIGNING

A common deficiency noted at many installations is conflicting sign messages, too many signs, or non-standard signing.

All signs should conform to FHWA's *Manual on Uniform Traffic Control Devices (MUTCD)*. All informational type signing that is not necessary outside the installation should be moved inside the installation boundary. A consistent signing plan should be in place on all gate approaches, as shown in Figure 4.

Answers from Page 2

1. Guard is standing, unprotected, in lane of traffic
2. Signing is not standard
3. Too many signs are present
4. Truck and passenger vehicles share the same gate.

Contact Us

Phone: DSN: 927-4313

- Rick Sumrak (757) 599-1170
  E-mail: SumrakR@tea-emh1.army.mil
- Richard Quesenberry (757) 599-1164
  E-mail: QuesenbR@tea-emh1.army.mil
- Paul Allred (757) 599-1190
  E-mail: AllredP@tea-emh1.army.mil

Fax: Commercial: (757) 599-1682 DSN: 927-2119

E-mail: Traffic@tea-emh1.army.mil

Mailing Address: MTMCTEA
Attn: MTTE-SA
720 Thimble Shoals Blvd., Suite 130
Newport News, VA 23606-4537

Reference List

- American Association of State Highway and Transportation Officials. ***A Policy on Geometric Design of Highway and Streets***. Washington, D.C. January 1996.
- American Association of State Highway and Transportation Officials. ***Roadway Design Guide***. Washington, D.C. January 2002.
- Military Traffic Management Command Transportation Engineering Agency. ***MTMCTEA Pamphlet 55-17, Better Military Traffic Engineering.*** Newport News, VA. January 1987.
- Military Traffic Management Command Transportation Engineering Agency. ***Traffic Engineering for Better Gates Bulletin.*** Newport News, VA. August 2001.
- Transportation Research Board, National Academy of Sciences. ***National Cooperative Highway Research Program (NCHRP) Report 350, Recommended Procedures for the Safety Performance Evaluation of Highway Features***. 1993.
- US Department of Transportation, Federal Highway Administration. ***Manual on Uniform Traffic Control Devices, Millennia Edition.*** Washington, D.C. 2001.
- www.tea.army.mil

Training

Continuing Education	Phone	Web Site
Penn State University; The Penn Transportation Institute	(814) 865-4700	www.pti.psu.edu
University of Maryland; Md. Transportation Technology Transfer Center	(301) 403-4623	www.ence.umd.edu/tttc
Georgia Institute of Technology	(404) 385-3501	www.gatech.edu
Northwestern University Center for Public Safety	(800) 323-4011	www.northwestern.edu/nucps/index.htm
Texas A&M University	(979) 845-3211	www.tamu.edu
University of Washington; College of Engineering	(206) 543-2100	www.engr.washington.edu/epp

Prepared with the assistance of Gannett Fleming

William J. Cooper
Director, MTMCTEA

DEPARTMENT OF THE ARMY
Military Traffic Management Command
Transportation Engineering Agency
720 Thimble Shoals Blvd., Suite 130
Newport News, Virginia 23606-4537

OFFICIAL BUSINESS

Supplement to Gates Revisited Bulletin

Military Traffic Management Command Transportation Engineering Agency
720 Thimble Shoals Boulevard, Suite 130 • Newport News, VA 23606-4537

June 2003

Concrete Barrier Placements and Arresting Devices

INTRODUCTION

Concrete barrier placements are commonly used to prevent high-speed, unauthorized vehicular entry through an installation gate. Arresting devices, which are typically centered on the roadway to stop traffic, have become commonplace to protect against this threat as well. Since they are placed within the travel way, these security measures introduce hazards to the motorist. To minimize these hazards, proper placement and adequate warning through signs and markings are essential. This special supplement is intended to provide guidance on how to address these safety issues.

CONCRETE BARRIER PLACEMENTS

Concrete barrier placements are discouraged on approaches to installation gates. Exposed blunt ends of concrete barriers present a hazard to traffic flow and motorists' safety. However, installations often see it as the only temporary means of controlling traffic before a permanent fix can be installed. To date, there has been little guidance on the suitability, layout, spacing, and delineation of barrier placements resulting in potential traffic safety and operational conflicts.

Common problems encountered at many military installations include:

- No warning signs of approaching speed reduction.
- Exposed barrier blunt ends.
- Barrier openings permitting a "straight-line" path.
- Barriers spaced too close resulting in conflicts with larger vehicle turning paths.
- Little or no delineation of the travel paths.

Contact Us

Phone: DSN: 927-4313

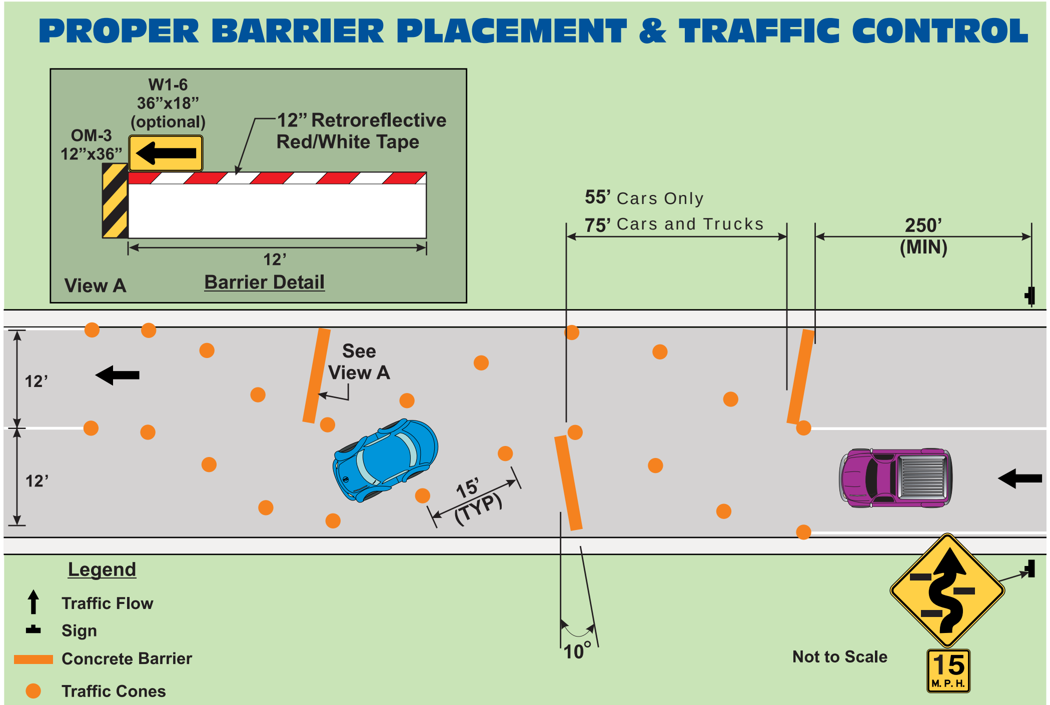
- Rick Sumrak (757) 599-1170
  E-mail: SumrakR@tea-emh1.army.mil
- Richard Quesenberry (757) 599-1164
  E-mail: QuesenbR@tea-emh1.army.mil
- Paul Allred (757) 599-1190
  E-mail: AllredP@tea-emh1.army.mil

Fax: Commercial: (757) 599-1682 DSN: 927-2119

E-mail: Traffic@tea-emh1.army.mil

Mailing Address: MTMCTEA
Attn: MTTE-SA
720 Thimble Shoals Blvd., Suite 130
Newport News, VA 23606-4537

The diagram at right shows the proper barrier spacing and orientation that will accommodate a WB-50 tractor trailer while still providing the desired level of speed reduction.



Delineation of barrier is often nonexistent, making it particularly difficult to negotiate a vehicle through the configuration at night. Red and white retroreflective tape should be installed, as shown above, to improve barrier visibility. Additional warning signs should be installed at least 250 feet before the first barrier.

ARRESTING DEVICES

The use of arresting devices is becoming quite common. These devices are often improperly delineated. They are marked with yellow along with either white or black diagonal stripes. The use of red and white stripes is more appropriate because of the stop condition that is required for the impact hazard (Figures 9.25 and 9.26 in AASHTO *Roadside Design Guide*, 2002). Additionally, since these devices are typically centered within the travel way, the diagonal striping should point down and outward from the center of the device. If located only on one side of moving traffic, the striping should point downward toward the traffic. Examples of nonstandard and standard arresting devices are shown.

Correct orientation, improper colors

Improper orientation and colors

Correct orientation, and colors